Aust. Wildl. Res., 1982, **9**, 221–27

The Abundance of Kangaroos in Suboptimal Habitats: Wheat, Intensive Pastoral, and Mallee

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Abstract

The densities of red and grey kangaroos in western Victoria and south-eastern South Australia were assessed by aerial survey. Much of the 133 000-km^2 area surveyed was farmed intensively for wheat and sheep but a significant proportion was largely unaltered mallee woodland or mallee heath. Of the total area, 85% had a density of less than one kangaroo per square kilometre, and 32% had a density of less than 0·01 km^{-2}, values considerably lower than those reported for pastoral areas in New South Wales and South Australia. Low densities in settled areas are attributed to intensive agricultural practices, small landholdings and lack of tree cover. Low densities in mallee may be due to the lack of palatable grasses and the absence of permanent watering points.

Introduction

The densities of grey kangaroos, *Macropus fuliginosus* and *M. giganteus*, and red kangaroos, *Macropus rufus*, were assessed by aerial survey in 133 000 km^2 of western Victoria and south-eastern South Australia. An additional survey of four National and State parks in western Victoria, conducted at a higher level of sampling intensity, complemented the broad area survey (Fig. 1).

Kangaroo numbers have been assessed in the pastoral zones of three states: New South Wales (Caughley *et al.* 1977), South Australia (Caughley and Grigg 1981) and Queensland (Caughley and Grigg, unpublished data). In each, a standardized technique of aerial survey (Caughley *et al.* 1976; Caughley 1977; Grigg 1979) has been employed. In New South Wales and South Australia, surveys are repeated annually to provide the information necessary to establish rates of commercial harvest of kangaroos (e.g. New South Wales: J. Caughley 1980; South Australia: Grigg and Caughley 1979; Grigg *et al.* 1980).

Patterns of land use in the present survey area are entirely different from those in areas in which surveys have been undertaken previously. Hence, even though kangaroos are not harvested commercially in Victoria (Poole 1978), an estimate of kangaroo numbers is of interest. Western Victoria and south-eastern South Australia are characterized by close settlement and intensive farming and grazing, in contrast to the extensive grazing of sheep in the pastoral zones of New South Wales, South Australia and Queensland. Remaining areas of natural habitat are almost exclusively mallee, a habitat described by Caughley *et al.* (1977) as 'a biological desert for macropods'.

Annual rainfall within the surveyed area varies from 292 mm at Mildura in the north to 775 mm at Mt Gambier in the south (Bureau of Meteorology). The major

form of land use is wheat–sheep farming, intensive grazing of sheep for wool being a secondary activity.

The natural vegetation grades from dry sclerophyll forest in the south, through temperate subhumid woodland, to mallee–heath and mallee woodland in the north (Moore 1970). Widespread clearing for farming and grazing has left few areas of natural vegetation, other than mallee, intact. The predominant vegetation in Little Desert National Park is mallee–heath, and that of the other three parks is mallee. Hattah–Kulkyne/Murray–Kulkyne National Park has substantial areas of riverine woodland and open grassland, but in Wyperfeld–Lake Albacutya National Park and Pink Lakes State Park these are comparatively minor habitat types.

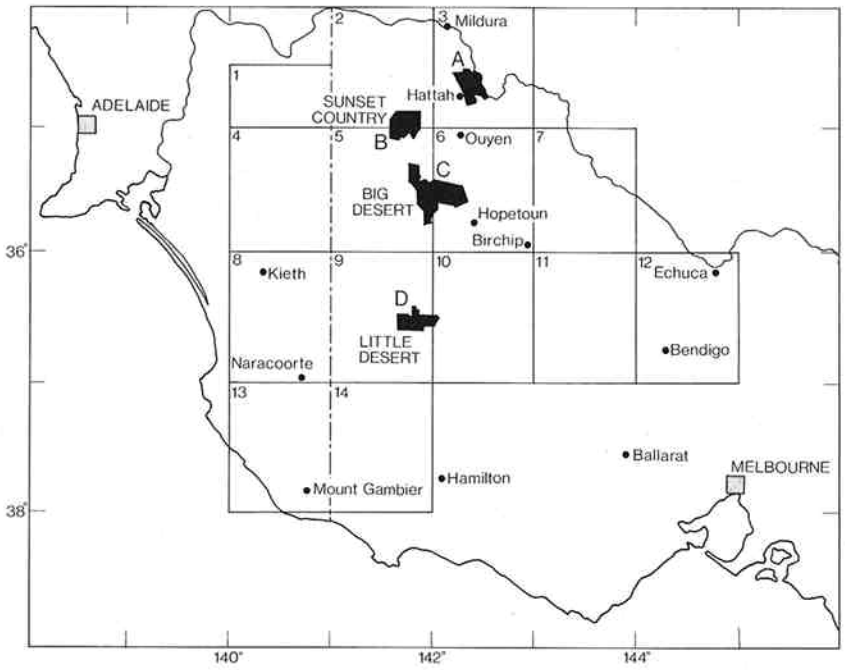

Fig. 1. Victoria and south-eastern South Australia, showing sample blocks and National and State parks surveyed for red and grey kangaroos. *A*, Hattah–Kulkyne National Park/Murray–Kulkyne Park. *B*, Pink Lakes State Park. *C*, Wyperfeld National Park–Lake Albacutya Park. *D*, Little Desert National Park.

Methods

Kangaroos were counted from a Cessna 182 or 206 aircraft flown at a constant ground speed of 185 km h^{-1} and at a constant height of 76 m above the ground. Two observers, one on either side of the plane, counted all kangaroos seen in transects delimited by streamers attached to the wing struts of the plane. These were positioned so that they demarcated a strip 200 m wide per observer when the plane was flown at survey height. In the extensive survey, transects were broken into units of 2 km^2 (400 m wide by 5 km of track) by an electronic timer which sounded a whistle every 97 s for 7 s. The latter interval was used for recording the numbers of red and grey kangaroos scored on that particular unit. The survey area was divided into degree blocks (1° latitude by 1° longitude), each with an area of approximately 10000 km^2. Blocks were sampled by two transects, one along 15′ of latitude and the other along 45′, to give a sampling intensity of approximately 0·65%. Raw counts of kangaroos were corrected for visibility bias in vegetation of different densities by the correction factors of Caughley *et al.* (1976).

No attempt was made to differentiate between *M. fuliginosus* and *M. giganteus* because their appearance from the air is similar. They were grouped as grey kangaroos. The boundary of distribution of each species in Victoria and South Australia is given in Poole (1977).

The four National and State parks were surveyed at higher intensities of sampling—20% for Hattah–Kulkyne/Murray–Kulkyne and Little Desert, 10% for Wyperfeld–Lake Albacutya and Pink Lakes. The small size of the parks allowed kangaroos to be counted on transects continuous across the width of each park, no rest periods being required.

Table 1. Estimated numbers and density of red and grey kangaroos in sample blocks in western Victoria and south-eastern South Australia

Values are ± standard error

Block No.	Grey kangaroos		Red kangaroos	
	Numbers	Density	Numbers	Density
1	0	0·0	0	0·0
2	5400 ± 5300	0·53 ± 0·52	0	0·0
3	21 300 ± 20 900	2·09 ± 2·05	2100 ± 600	0·21 ± 0·06
4	700 ± 600	0·07 ± 0·06	0	0·0
5	300 ± 300	0·03 ± 0·03	0	0·0
6	2100 ± 2100	0·21 ± 0·21	1000 ± 1000	0·10 ± 0·10
7	1700 ± 1600	0·17 ± 0·16	0	0·0
8	23 700 ± 20 200	2·38 ± 2·03	0	0·0
9	0	0·0	0	0·0
10	0	0·0	0	0·0
11	0	0·0	0	0·0
12	2600 ± 2500	0·27 ± 0·25	0	0·0
13	700 ± 900	0·10 ± 0·12	0	0·0
14	2500 ± 300	0·25 ± 0·03	0	0·0
Total	60 900 ± 29 900		3100 ± 1200	

Results

Extensive Survey

Grey kangaroos were recorded at densities of less than 0·01 per square kilometre in 32% of the area surveyed. Of the total area, 85% had a density of less than 1·0 per square kilometre. The exceptions were one area in Victoria (2·09 per square kilometre), which included Hattah–Kulkyne National Park, and an area in south-eastern South Australia between Keith and Naracoorte (2·38 per square kilometre). A total of 36 000 ± 22 000 (mean ± SE) grey kangaroos were recorded in western Victoria (an area of 100 000 km^2) and 25 000 ± 20 000 in south-eastern South Australia (33 000 km^2). Totals and densities for each sample block are given in Table 1.

Red kangaroos were recorded in only two of the degree blocks (blocks 3 and 6; Table 1) covering an area from Mildura south through Hattah, Ouyen and Hopetoun to Birchip. Densities in these two blocks averaged 0·15 per square kilometre, to give an overall total of 3 000 ± 1 000.

Intensive Survey

Densities of grey kangaroos in the four parks ranged from 0·18 per square kilometre in Little Desert to 18·12 per square kilometre in Hattah–Kulkyne/Murray–Kulkyne (Table 2). Densities in each park were from seven to ten times higher than the average within the degree block(s) in which that park occurred. All

parks lie beyond the western boundary of *M. giganteus* deduced by Poole (1977). Hence all grey kangaroos recorded for the four parks are likely to be *M. fuliginosus*.

Red kangaroos were recorded in Pink Lakes State Park (0·13 per square kilometre) and Hattah–Kulkyne/Murray–Kulkyne (0·77 per square kilometre).

Table 2. Estimated numbers and density of western grey and red kangaroos in four National or State parks in western Victoria

Values are ± standard errors

Park	Western grey kangaroos		Red kangaroos	
	Numbers	Density	Numbers	Density
Hattah–Kulkyne/Murray–Kulkyne	8980±1390	18·12±2·80	380±120	0·77±0·24
Wyperfeld–Lake Albacutya	1800±550	1·62±0·50	0	0·0
Pink Lakes	1080±480	2·13±0·96	60±70	0·13±0·14
Little Desert	60±20	0·18±0·06	0	0·0

Discussion

Grey Kangaroos

The density of grey kangaroos in western Victoria and south-eastern South Australia is only 15% of that recorded for the pastoral zone of New South Wales (Caughley *et al.* 1977) and 38% of that of the pastoral zone of South Australia (Caughley and Grigg 1981) (Table 3). Such low densities appear to reflect the effects of intensive land use and the marginal nature for kangaroos of the remaining areas of natural vegetation.

Table 3. Comparison of densities of kangaroos between areas of differing land use

Densities are means, with ranges in parentheses. *Macropus* spp. are *M. fuliginosus* and *M. giganteus*

	Western New South Wales	South Australia	Western Victoria and SE. South Australia
Major land use	Extensive sheep grazing	Extensive sheep grazing	Wheat and intensive sheep grazing
Species and density	*M. rufus* 4·18 (0–14·53) *Macropus* spp. 3·18 (0·03–13·23)	*M. rufus* 4·62 (0–12·98) *M. fuliginosus* 1·22 (0–5·01)	*M. rufus* 0·15 (0–0·21) *Macropus* spp. 0·46 (0–2·38)
Reference	Caughley *et al.* 1977	Caughley and Grigg 1981	This paper

The predominant form of land use in the area of survey is wheat–sheep farming, as against extensive grazing of sheep for wool in the pastoral areas of New South Wales and South Australia. Wheat farming is a highly mechanized form of land use requiring large paddocks with few trees. Shelter belts of natural vegetation between paddocks are usually lacking, and the only remaining stands of natural vegetation are thin ribbons of trees along road verges. This represents poor habitat for grey kangaroos, which prefer ecotones where substantial areas of forest providing cover abut open grassy feeding grounds (Kirkpatrick 1967; Bell 1973; Stewart 1975). Kangaroos remaining in cultivated areas are reported to do substantial damage to cereal crops both by feeding and trampling (Dempster 1961). They also damage

fences. Reduced forest or scrub cover exposes kangaroos in these areas to the resulting control measures mounted by farmers.

The low density of kangaroos in cultivated areas, particularly wheat-growing areas, appears to be a general phenomenon. Scott-Kemmis (1979) found that grey kangaroos were sparse in cultivated areas of New South Wales. Similarly, a survey of road kills of grey kangaroos in central New South Wales during 1980 (Short, unpublished observations) yielded 16·7 kills per 100 km in predominantly pastoral areas (Cobar–Trangie), compared to 1·6 per 100 km in areas where the dominant land use is the cultivation of wheat (Trangie–Parkes).

A further factor contributing to the low densities of grey kangaroos observed in this survey would appear to be the unsuitability for kangaroos of remaining areas of natural vegetation, mainly mallee or mallee–heath. Clear evidence of this antipathy of kangaroos towards mallee was provided by the aerial survey of Hattah–Kulkyne/Murray–Kulkyne. Kangaroos were concentrated in the open grassland and riverine forest at densities of an order of magnitude greater than those of the mallee.

The unsuitability of mallee for kangaroos may reflect a lack of available food and water. Eastern grey kangaroos feed almost exclusively on grasses (Kirkpatrick 1965; Bell 1973; Taylor 1980), yet mallee is characterized either by the lack of an understorey or by an understorey of sclerophyllous shrubs with little grass (Beadle 1948). On light, sandy soils, however, porcupine grass *Triodia irritans* may occur. Grasses of this genus are highly lignified (Burbidge 1946) and generally unpalatable (Whittet 1964). Although eastern grey kangaroos are known to feed on *Triodia*, particularly the seed heads (Griffiths and Barker 1966), it seems unlikely that they could subsist on a diet primarily of *Triodia*. Eastern grey kangaroos with a food intake of between 32 and 48 g kg $W^{-0.75}$ (Forbes and Tribe 1970) would obtain 0·18–0·27 g kg $W^{-0.75}$ day^{-1} of nitrogen (assuming 0·56 g of nitrogen per 100 g dry weight of spinifex: Griffiths and Barker 1966), insufficient to maintain a positive nitrogen balance (Forbes and Tribe 1970).

Although little is known of the absolute water requirements of either *M. fuliginosus* or *M. giganteus*, it would seem that the lack of availability of surface water may be a factor limiting their densities and distributions within the more extensive areas of mallee such as the Big Desert and the Sunset Country of Victoria. Much of the mallee and mallee–heath occurs on deep, sandy soils, the porous nature of which, when combined with hot, dry summers and frequent drought (Land Conservation Council 1974), results in little or no permanent surface water.

Red Kangaroos

Red kangaroos were observed on only two degree blocks in north-western Victoria, much of the surveyed area lying beyond their range of distribution. Reds occur to the west of these two grid squares (e.g. in Pink Lakes State Park) but either at very low densities or in scattered patches such that they were missed by the low-intensity, scanning survey.

There are no records of reds ever having occurred in the Wimmera district in central–western Victoria (blocks 9 and 10; Fig. 1) (Dixon and Huxley 1979*a*) or to the east or south of Swan Hill in the Murray district of Victoria (block 12; Fig. 1) (Dixon and Huxley 1979*b*). Hence, the boundary of distribution appears to have been static for over a century. Land use patterns are therefore probably not a major determinant of the boundary of distribution of red kangaroos in Victoria. Frith (1973) noted that the boundary of distribution coincided roughly with the 380-mm

(15-in.) annual isohyet. The latter cuts western Victoria in an east–west line just to the north of latitude 36°S. (Gaffney 1970). Caughley *et al.* (1977), however, found high densities of reds in the Jerilderie district of southern New South Wales, close to the boundary of their distribution. From this they inferred that the boundary was determined by changes in topography and associated habitats rather than by climate.

With few exceptions, densities of kangaroos in western Victoria and south-eastern South Australia are a small fraction of those of the pastoral areas of New South Wales and South Australia, despite the presence of significant areas of unmodified mallee habitat in reserves and on crown land. Both mallee areas and land utilized intensively for wheat cropping or grazing represent poor habitat for kangaroos. Water and food appear to be in short supply in the former, while shelter is largely absent from the latter. Further, because of the nature of the land use in cultivated areas, landowners are less tolerant of kangaroos and more able to control them.

Acknowledgments

We would like to thank G. Caughley, P. Harlow and L. Smith, who each observed on one of the two Victorian surveys, and G. Wilson, who ably piloted the plane for the intensive survey. We gratefully acknowledge the financial support of the National Parks Service, Victoria. We would like, also, to express our appreciation to S. Cowling for valuable encouragement and to G. Caughley who critically reviewed the manuscript.

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Manuscript received 20 July 1981; accepted 15 October 1981